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OIPE IAP59 JUN 13 2006 PATENT & TRADEMARK OFFICE

ATTORNEY DOCKET NO. **10020908-1**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Thomas W. Stone

Serial No.: 10/717,326 | **Examiner: James P. Hughes**

Filing Date: November 18, 2003 | **Group Art Unit: 2883**

Title: Methods and Systems for Chromtic Disperson Compensation in Switched Grating WDM...

MAILSTOP APPEAL BRIEF-PATENTS
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TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) **$500.00**.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

☐ (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)(1)-(5)) for the total number of months checked below:

☐	one month	$ 120.00
☐	two months	$ 450.00
☐	three months	$1020.00
☐	four months	$1590.00

☐ The extension fee has already been filled in this application.

☒ (b) Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **50-3718** the sum of $500.00. At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account **50-3718** pursuant to 37 CFR 1.25.

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Respectfully submitted,

Thomas W. Stone

By

Jacob No. Erlich
Attorney/Agent for Applicant(s)

Reg. No. 24,338

Date: June 13, 2006

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Jacob N. Erlich
Reg. No. 24,338

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

Appellants: Thomas W. Stone
Serial No.: 10/717,326
Filed: November 18, 2003
Examiner: James P. Hughes
Group Art Unit: 2883
Title: METHODS AND SYSTEMS FOR CHROMATIC DISPERSION COMPENSATION IN SWITCHED GRATING WDM DEVICES

AVAGO TECHNOLOGIES, LTD.
P.O. Box 1920
Denver, Colorado 80201-1920

TO: Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

BRIEF FOR APPELLANTS

Sir:

This is an appeal from the Final Rejection dated February 10, 2006 of claims 1 and 3-21 in the above-identified application. This appeal is timely filed, being filed within two month of the date at which the Notice of Appeal was filed at the Patent and Trademark Office, April 13, 2006.

Table of Contents

REAL PARTY OF INTEREST

The real party of interest is the Assignee, AVAGO TECHNOLOGIES FIBER IP (SINGAPORE) PTE. LTD, having offices at Denver, CO.

RELATED APPEALS AND INTERFERENCES

None.

STATUS OF CLAIMS

Claims 1 and 3-21 remain pending in this application. The claims currently on appeal are claims 1 and 3-21. No claims were allowed; claims 1 and 3-21 were rejected. A copy of the claims on appeal is provided in the Claims Appendix.

STATUS OF AMENDMENTS

The Response After Final, dated April 10, 2006 (received at the USPTO on April 13, 2006) , was not entered per Advisory Action dated April 24, 2006. In the response dated April 10, 2006, claims 1, 8 and 14 were amended to render the meaning of the claims clearer and unequivocal to one of ordinary skill in the art, adding only terms available to one of ordinary skill in the art and which would have been understood as being in the claims before amendment.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 1, 8 and 14 are involved in this appeal. Dependent claims 2-7, 9-13 and 15-21 are also involved in the appeal and are argued separately.

Independent claim 1 claims a method for compensating for the chromatic dispersion in optical systems. The method of claim 1 includes the steps of: separating input optical radiation into distinct chromatic components, propagating the distinct chromatic components through an optical system, the propagating including the steps of reflecting the distinct chromatic components from a holographic mirror; providing, through the reflecting, a pre-selected relationship between optical path lengths of the distinct chromatic components, the pre-selected relationship substantially compensating for the chromatic dispersion, recombining the distinct chromatic components, after propagating through the optical system.

In order to provide the pre-selected relationship, the holographic mirror has reflection properties different from a conventional mirror, wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror. In reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface.

An embodiment of the method of this invention can be best understood by reference to Figs.1, 2, 3, 4 submitted by the Applicant. In Fig. 1, in the optical system 5, input optical radiation 10 is separated into distinct chromatic components 25, 35 by fixed grating 20. The distinct chromatic components 25, 35 are directed towards a pixellated optical reflector 40 by fixed grating 30. Fixed gratings 20, 30 separate the distinct chromatic components 25, 35. The distinct chromatic components 25, 35 are reflected from the pixellated volume optical reflector 40. Volume optical reflector 40 in Fig. 1 reflects the distinct chromatic components 25, 35 such that the angle of reflection is the negative of the angle of incidence (the rays are returned along the path that the rays came in as incident and the rays are incident along a normal to the surface of the pixellated volume optical reflector 40).

The incident (incoming) beam and the reflected (outgoing) beam are substantially coincident. In a conventional mirror, the angle of incidence measured with respect to the normal to the surface of the mirror equals the angle of incidence measured with respect to the normal to the surface of

the mirror. (See paragraphs 19-24 of the Applicant's specification for a description of the methods as applied to Fig. 1). The pixellated volume optical reflector 40 can be a switchable pixellated holographic mirror. A switchable holographic mirror may be a device such as that disclosed in U. S. Patent Serial No. 5,771,320 (issued to T. W. Stone on June 23, 1998), and U. S. Patent Serial No. 6,072,923 (issued to T. W. Stone on June 6, 2000). The distinct chromatic components 25, 35 in the reflected beam are converged towards fixed grating 20 by fixed grating 30. The recombining of the distinct chromatic components 25 - 35 in the reflected beam is completed by fixed grating 20.

Similarly, in the system shown in Fig. 2, a fixed volume holographic mirror 80 replaces the pixellated switchable volume optical reflector 40 of Fig. 1. Here again, the incident (incoming) beam and the reflected (outgoing) beam are substantially coincident. (Other embodiments of the volume optical reflector 80 include a phase conjugate mirror.) See paragraphs 25-29 of the Applicant's specification for a description of the methods as applied to Fig. 2.

In the system shown in Fig. 3, the distinct chromatic components 125, 135 are reflected by the optical reflector 150, a tilted holographic mirror. Here again, the incident (incoming) beam and the reflected (outgoing) beam are substantially coincident.. See paragraphs 30-33 of the Applicant's specification for a description of the methods as applied to Fig. 3.

In the system shown in Fig. 4, the distinct chromatic components 125, 135 are reflected by the optical reflector 150. Again, the incident (incoming) beam and the reflected (outgoing) beam are substantially coincident.. See paragraph 34 of the Applicant's specification for a description of the methods as applied to Fig.4.

The reflecting and propagating through each of the systems shown in Figs. 1-4 provides a pre-selected relationship between optical path lengths through the optical system 65 of the distinct chromatic components. That pre-selected relationship substantially compensates the chromatic dispersion.

Claim 3 recites the method of claim 1 wherein the holographic mirror is a switchable pixellated holographic mirror, such as the pixellated volume optical reflector 40 in Fig. 1.

Claim 4 recites the method of claim 1 further comprising the step of focusing the input optical radiation. For example, in Fig. 1, the input 10 is weakly focused onto the pixellated volume optical reflector 40 by t a cylindrical lens 67 since the distance to the mirror is roughly the same for all wavelengths. A spherical lens could also be used. (See paragraph 20 and par. 32.)

Claim 5 recites the method of claim 1 wherein the step of separating input optical radiation into distinct chromatic components comprises the step of propagating the input optical radiation through at least one separating diffraction grating. Referring to Fig. 3, during operation, input optical radiation 110, from an input beam/port 115, is separated into m distinct chromatic components, labeled 125 through 135, by fixed grating 120 (par. 31).

Claim 6 recites the method of claim 5 wherein the step of recombining the distinct chromatic components comprises the step of propagating the distinct chromatic components through at least one recombining diffraction grating. Referring to Fig. 4, a recombining grating pair 190 and 200 combines any chromatic components present in a given column into one element of an array of N multiplexed output channels (par. 34).

Claim 7 recites the method of claim 6 wherein the one or more recombining diffraction gratings are also used as the one or more separating diffraction gratings. Fig. 1 and Fig. 2 show systems where the one or more recombining diffraction gratings are also used as the one or more separating diffraction gratings. Paragraphs 24 and 26-29 describe the operation of the systems of Fig. 1 and Fig. 2 respectively.

Claim 8 recites a system including an optical separating sub-system capable of separating input optical radiation into distinct chromatic components, an optical recombining sub-system capable of recombining the distinct chromatic components for output, and, a volume holographic mirror

capable of reflecting the distinct chromatic components and providing, through such reflecting, a pre-selected relationship between optical path lengths through the optical systems of the distinct chromatic components, the pre-selected relationship substantially compensating chromatic dispersion; the volume holographic mirror being optically disposed between the optical separating sub-system and the optical recombining sub-system. In order to provide the pre-selected relationship, the holographic mirror has reflection properties different from a conventional mirror, wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror. In reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface. Embodiments of the system of claim 8 are shown in Figs.1, 2, 3, 4 submitted by the Applicant.

Claim 9 recites the optical system of claim 8 also including a switchable element selected from the group consisting of a switchable grating, a switchable mirror array, a switchable liquid crystal array, a cross-connect, an add-drop multiplexer, an interleaver and a band channelizer; the switchable element optically interposed between the volume holographic mirror and theoptical recombining sub-system. Fig. 2 depicts an embodiment of the system of claim 9 wherein the switchable element 70 is a switchable grating or a switchable liquid crystal array or a switchable mirror array or similar component (par. 25). Fig. 4 shows another embodiment of the system of claim 9 that utilizes electrically switchable diffractive gratings as the switchable optical element 180. Other embodiments of the switchable optical element 180 include switchable mirror arrays, switchable liquid crystal arrays, a cross-connect, an add-drop multiplexer, an interleaver or a band channelizer (par. 35).

Claim 10 recites the optical system of claim 8 also including an optical focusing component capable of focusing separated input optical radiation onto the volume holographic mirror. For example, in Fig. 1, the input 10 is weakly focused onto the pixellated volume optical reflector 40

by a cylindrical lens 67 since the distance to the mirror is roughly the same for all wavelengths. A spherical lens could also be used. (See paragraph 20 and par. 32.)

Claim 11 recites the optical system of claim 8 wherein the volume holographic mirror comprises a pixellated switchable holographic mirror. The pixellated volume optical reflector 40 of Fig. 1 can be a switchable pixellated holographic mirror (par. 23).

Claim 12 recites the optical system of claim 8 wherein the optical recombining sub-system is the same as the optical separating sub-system. Fig. 1 and Fig. 2 show systems where the one or more recombining diffraction gratings (the optical recombining sub-system) are also used as the one or more separating diffraction gratings (the optical separating sub-system) . Paragraphs 24 and 26-29 describe the operation of the systems of Fig. 1 and Fig. 2 respectively.

Claim 13 recites optical system of claim 9 further comprising a directing optical element capable of directing the separated input optical radiation to the volume holographic mirror, and, a redirecting optical element capable of redirecting optical radiation reflected from the volume holographic mirror to the switchable element. Referring to Fig. 3, the system 100 includes, a directing optical element 140, such as, but not limited to, a polarizing beamsplitter with a quarter wave plate, a redirecting optical element 160, such as, but not limited to, the same polarizing beamsplitter used in the directing optical element 140 with another waveplate used to re-rotate the polarization state of the light (par. 30).

Claim 14 recites chromatic dispersion compensated optical system comprising a pair of separating diffraction gratings capable of separating input optical radiation into distinct chromatic components, a holographic mirror capable of reflecting the distinct chromatic components and providing, through the reflecting, a pre-selected relationship between optical path lengths of the distinct chromatic components through the optical system, the pre-selected relationship substantially compensating chromatic dispersion; a switchable element capable of receiving the separated distinct chromatic components and outputting separated distinct output chromatic components, and, a pair of recombining diffraction gratings capable of recombining

the outputted separated distinct chromatic components; the switchable element being optically interposed between the holographic mirror and one of the pair of recombining diffraction gratings. In order to provide the pre-selected relationship, the holographic mirror has reflection properties different from a conventional mirror, wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror. In reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface. Embodiments of the system of claim 14 are shown in Figs. 3 and 4.

Claim 15 recites the system of claim 14 also including a switchable element selected from the group consisting of a switchable grating, a switchable mirror array, a switchable liquid crystal array, a cross-connect, an add-drop multiplexer, an interleaver and a band channelizer; the switchable element optically interposed between the volume holographic mirror and theoptical recombining sub-system. Fig. 2 depicts an embodiment of the system of claim 9 wherein the switchable element 70 is a switchable grating or a switchable liquid crystal array or a switchable mirror array or similar component (par. 25). Fig. 4 shows another embodiment of the system of claim 9 that utilizes electrically switchable diffractive gratings as the switchable optical element 180. Other embodiments of the switchable optical element 180 include switchable mirror arrays, switchable liquid crystal arrays, a cross-connect, an add-drop multiplexer, an interleaver or a band channelizer (par. 35).

Claim 16 recites the system of claim 14 also including an optical focusing component capable of focusing separated input optical radiation onto the volume holographic mirror. For example, in Fig. 3, cylindrical lens 67 may be used to focus the neighboring distinct chromatic components on the volume holographic mirror 150 so that the chromatic components are spatially narrow in the dimension of the tilt (par. 32).

Claim 17 recites the system of claim 14 wherein the pair of recombining diffraction gratings is the same as the pair of separating diffraction gratings. Fig. 1 and Fig. 2 show systems where the pair of recombining diffraction gratings are also used as the pair of separating diffraction gratings.. Paragraphs 24 and 26-29 describe the operation of the systems of Fig. 1 and Fig. 2 respectively. Claim 18 recites the optical system of claim 9 further comprising a directing optical element capable of directing the separated input optical radiation to the volume holographic mirror, and, a redirecting optical element capable of redirecting optical radiation reflected from the volume holographic mirror to the switchable element. Referring to Fig. 3, the system 100 includes, a directing optical element 140, such as, but not limited to, a polarizing beamsplitter with a quarter wave plate, a redirecting optical element 160, such as, but not limited to, the same polarizing beamsplitter used in the directing optical element 140 with another waveplate used to re-rotate the polarization state of the light (par. 30).

Claim 19 recites optical system of claim 8 wherein the optical separating sub-system comprises a pair of diffraction gratings. Embodiments of the system of claim 19 are shown in Figs. 3 and 4.

Claim 20 recites optical system of claim 8 wherein the optical recombining sub-system comprises a pair of diffraction gratings. Embodiments of the system of claim 19 are shown in Figs. 3 and 4.

Claim 21 recites the optical system of claim 8 wherein the volume holographic mirror comprises a phase conjugate mirror. Embodiments of the volume optical reflector 80 of Fig. 2 include, but are not limited to a phase conjugate mirror. As can be seen from Figs. 3 and 4, if the volume optical reflector is not pixellated, a phase conjugate mirror could be used.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(a) Claims 1, 3-13, 18 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bouevitch (U.S. 2003/0021526) ("Bouevitch") in view of Stone (U.S. patent 6,072,923, the '923 patent); and

(b Claims 14-17 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bouevitch in view of Shirasaki (U.S. 2002/0114090) ("Shirasaki").

ARGUMENT

The issues on this appeal relate to the applicability of obviousness on standards of the patent law.

Claims 1, 3-13, 18 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bouevitch (U.S. 2003/0021526) ("Bouevitch") in view of Stone (U.S. patent 6,072,923)

Claim Construction

As stated in the response received at the USPTO on October 17, 2005 (filed October 13, 2005) to the office action dated July 13, 2005, the angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror is usually referred to as the angle of reflection. In the customary definition of the angle of incidence and the angle of reflection (see, for example, any textbook in optics such as E. Hetch, *Optics*, ISBN 0-201-11609-X, pp. 83 and 154, a copy of which is provided in the Evidence Appendix; see also Feynman Lectures on Physics, Vol. 1, p. 26-2, ISBN 0-201-02116-1-P, a copy of which is also provided in the Evidence Appendix) both angles are measured at substantially a location of incidence, and describes the physical relationship between incoming and outgoing radiation at the holographic mirror such as that shown in Figs. 2, 3 and 4 of the Applicant's specification.

The first step in determining whether a claim is anticipated, or is obvious in view of prior art, is to interpret the claim. ("It is elementary in patent law that, in determining whether a patent is valid ...., the first step is to determine the meaning and scope of each claim in suit." *Lemelson v. Gen. Mills, Inc.*, 968 F.2d 1202, 1206, 23 U.S.P.Q.2D (BNA) 1284, 1287 (Fed. Cir. 1992).) When not defined by applicant in the specification, the words of a claim must be read as they would be interpreted by those of ordinary skill in the art. (MPEP 211.01) (*Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342, 60 USPQ2d 1851, 1854 (Fed. Cir. 2001) ("explaining the court's analytical process for determining the meaning of disputed claim terms")). "During examination, 'claims . . . are to be given their broadest reasonable interpretation consistent with the specification, and . . . claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art.'" *In re Am. Acad. Sci. Ctr.*, 367 F. 3d 1359, 1354 (Fed. Cir. 2004).

Giving the claims their broadest interpretation as understood by those of ordinary skill in the art, the holographic mirrors in the claims have an angle of reflection (the angle of reflection being defined in any optics text such as Hetch, *Optics*, ISBN 0-201-11609-X, pp. 83 and 154 or in Feynman Lectures on Physics, Vol. 1, p. 26-2, ISBN 0-201-02116-1-P) different from the angle of incidence (as defined in any optics text such as Hetch, *Optics*, ISBN 0-201-11609-X, pp. 83 and 154 or in Feynman Lectures on Physics, Vol. 1, p. 26-2, ISBN 0-201-02116-1-P). One of ordinary skill in the art, following the teaching of any optics or undergraduate physics text, would understand a mirror to have an angle of incidence and an angle of reflection defined at the point of incidence. In the '923 patent asserted by the Examiner and in the Applicant's invention, when a holographic mirror is used, the point of incidence and the point of reflection are the same, as would be the case in any mirror that behaves according to what is taught in optics and physics texts. (Also in the Applicant's invention, the incident (incoming) beam and the reflected (outgoing) beam are substantially coincident. (see Figs.1, 2, 3 and 4 in the above Applicant's patent application). <u>In the reference asserted by the Examiner, "Stone" (6,072,923- the '923 patent), in every embodiment of a holographic mirror shown (see, for example, Fig. 4 of the '923 patent) the point of incidence and the point of reflection are the same.</u> Thus,

hereinbelow, in a mirror, holographic or not, the point of incidence and the point of reflection are the same.

Obviousness

There is no motivation, suggestion or teaching (hereinafter referred to as motivation), either in the references themselves, in the knowledge of one of ordinary skill in the art, or, in the problem being solved, of the desirability to replacing the optical elements used by Bouevitch with a holographic mirror with reflection properties different from a conventional mirror; wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror; whereby, in reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface.

Furthermore, replacing the optical elements used by Bouevitch with a holographic mirror with reflection properties different from a conventional mirror as defined in the independent claims; wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror; whereby, in reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface, renders Bouevitch unsatisfactory for its intended purpose.

Detailed arguments are provided hereinbelow in support of the above statement.

1) *Replacing the modifying means 150 or 650 of Bouevitch with a holographic mirror with reflection properties different from a conventional mirror renders Bouevitch unsatisfactory for its intended purpose.*

The Examiner states that Bouevitch teaches "modifying means 150 including at least one optical element capable of modifying a property of at least a portion of a beam of light and reflecting the modified beam of light back in substantially the same direction from which it originated." Bouevitch describes the modifying means 150 in Figures 3a-3d and in Figures 4b-4c. One salient characteristic of the modifying means 150 of Bouevitch is that, although the outgoing beam, 102b, (which the Examiner considers equivalent to the reflected beam) propagates in a direction anti-parallel to the direction of propagation of the incident beam, 102a, the outgoing beam is separated by a distance from the incoming beam. In the '923 patent asserted by the Examiner and in the Applicant's invention, when a holographic mirror is used, the point of incidence and the point of reflection are the same, as would be the case in any mirror that behaves according to what is taught in optics and physics texts. In the Applicant's invention, when a holographic mirror is used, the incident (incoming) beam and the reflected (outgoing) beam are substantially coincident. (see Figs. 2, 3 and 4 in the above Applicant's patent application). <u>Also, according to Fig. 4 of the '923 patent asserted by the Examiner, if a holographic mirror is capable of modifying a property of at least a portion of a beam of light and reflecting the modified beam of light back in substantially the same direction from which it originated, the incident (incoming) beam and the reflected (outgoing) beam would be substantially coincident.</u> Assuming that, for arguments sake, the modifying means 150 or 650 of Bouevitch are replaced , as suggested by the Examiner, by modifying means in which the outgoing beam propagates in substantially the same path as the incoming beam, the resulting modified Figures 1a and 6a and 7 of Bouevitch are shown below.

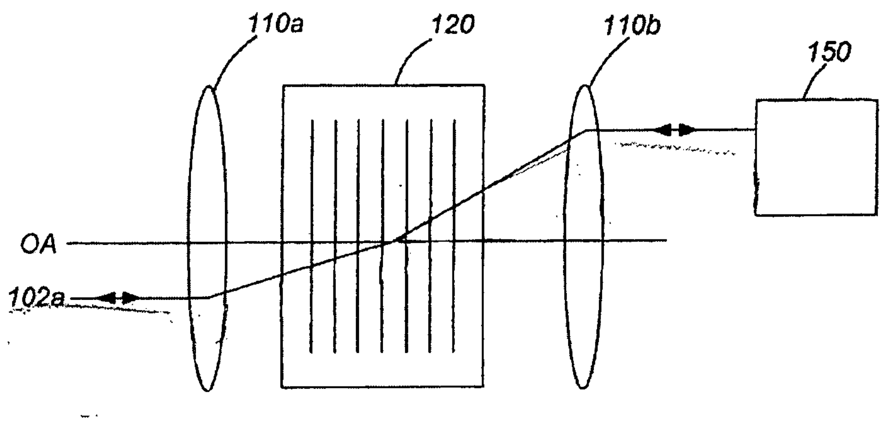

FIG. 1a

MODIFIED

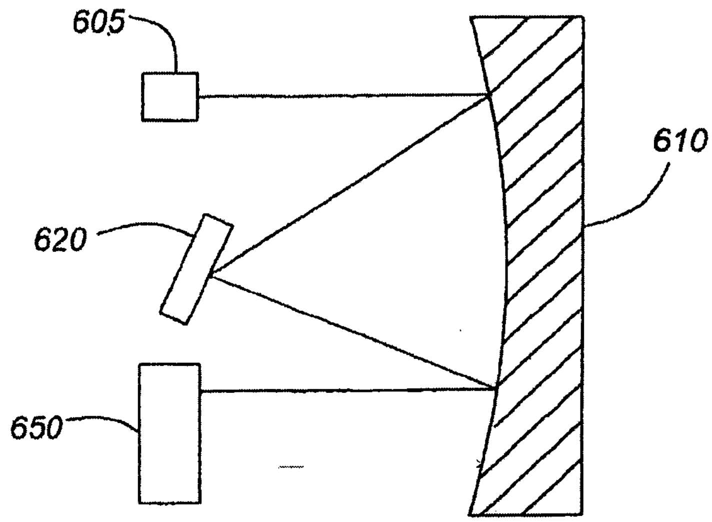

FIG. 6a

(MODIFIED)

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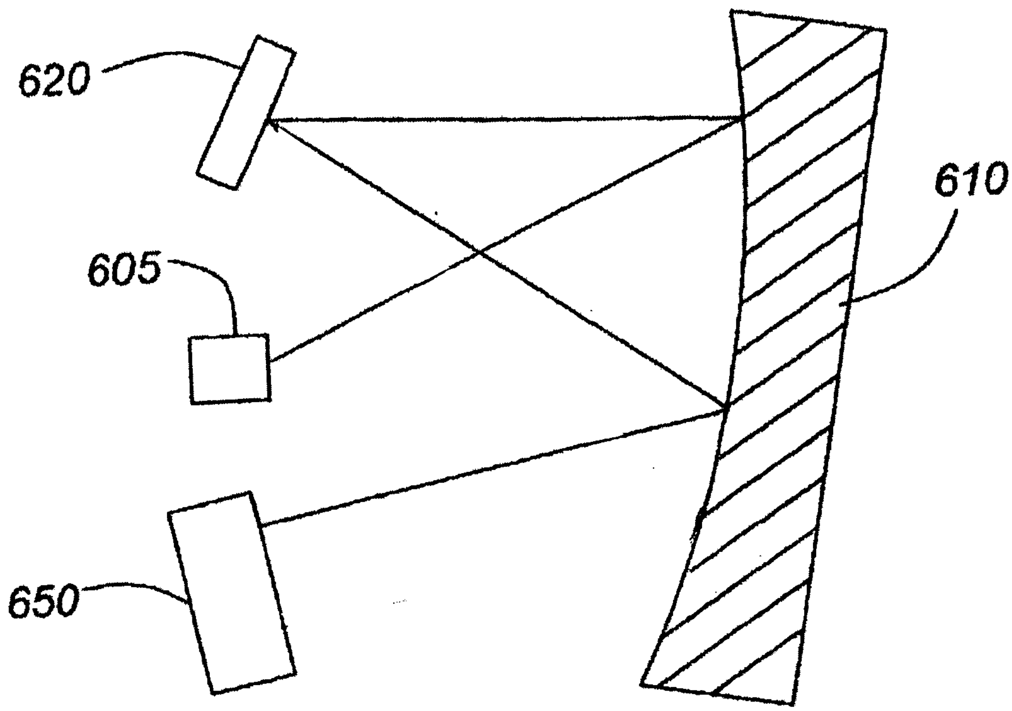
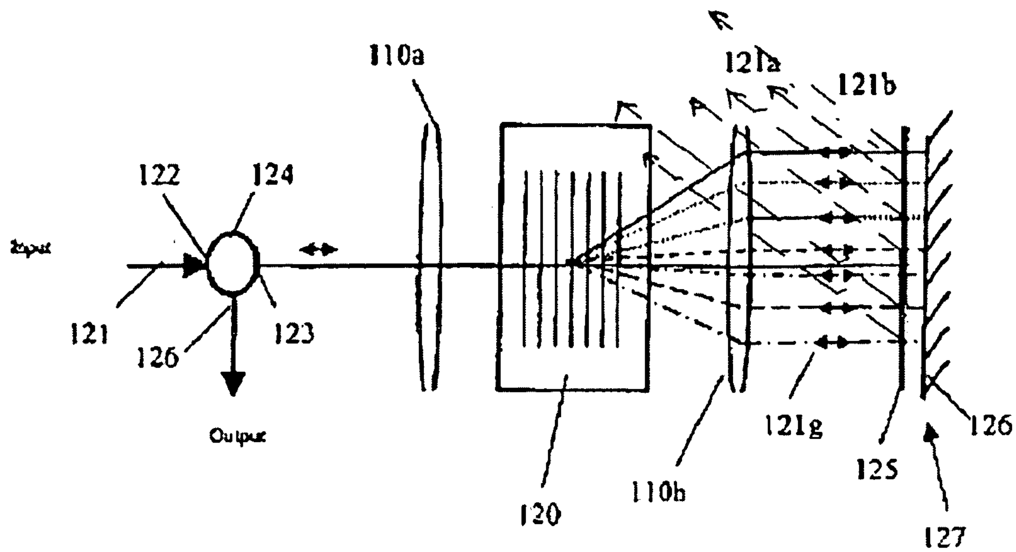


FIG. 7

(MODIFIED)

Replacing the optical reflector in Figure 1b of Bouevitch with a holographic mirror, such as that disclosed in the '923 patent or recited in the Applicant's claimed invention, also renders in the system disclosed by Bouevitch not operable for the purpose was intended for. Referring to the modified Figure 1b shown below, the reflected beams (shown by the dashed lines) will either miss the grating 120 or, if deflected by the mirror 110b, will be diffracted out of the system.



The modified version of Figures 1a, 1b, 6a and 7 of Bouevitch do not provide the chromatic dispersion compensation that the original systems shown in the original figures were designed to provide. Applicant respectfully asserts that the combination proposed by the Examiner would render the invention of Bouevitch unsuitable for the purpose it was intended for.

Applicant respectfully asserts that there is no motivation to modify Bouevitch by replacing the modifying means 150 or 650 with holographic mirrors as set forth in the Applicant's claimed invention, holographic mirrors having "reflection properties different from a conventional mirror, [such that,] in reflecting the distinct chromatic components, a direction of propagation of said distinct chromatic components is altered by means of diffraction by said holographic mirror; and whereby, in reflecting said distinct chromatic components by means of diffraction, an angle of

incidence does not equal an angle between a direction of propagation of said reflected distinct chromatic components and a normal to a surface of said holographic mirror, said reflected distinct chromatic components emanating from said surface," since that replacement would render the Bouevitch invention inoperable as shown above. If the references when combined would render the prior art invention being modified unsatisfactory for its intended purpose, there is no motivation to combine the references. *McGinley v. Franklin Sports, Inc.*, 262 F.3d at 1354; *In re Gordon*, 733 F.2d at 902. Therefore, there is no motivation to modify Bouevitch by replacing modifying means with holographic mirrors such as those in the Applicant's claimed invention. Or in the '923 patent.

2) *mere identification in the prior art of each element is insufficient to defeat the patentability of the combined subject matter as a whole.*

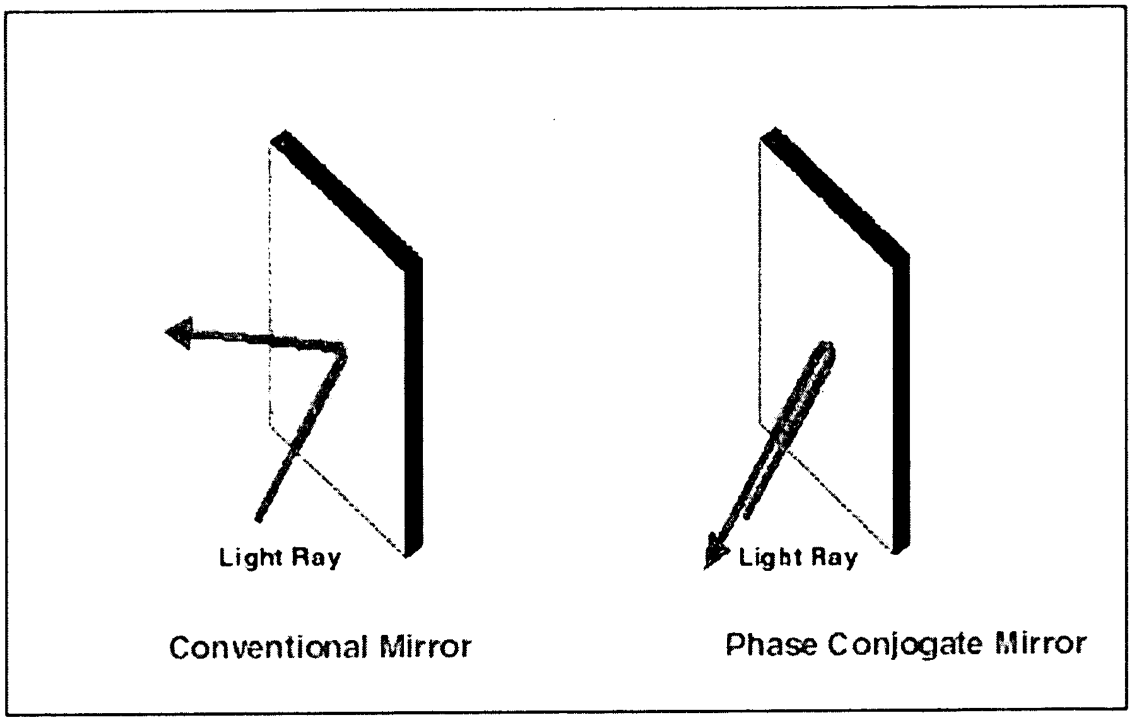
The Examiner states that holographic mirrors are known in the art. Applicant states that most optical elements are known and inventions in the optical field, as in most other art areas, arise from a combination of old elements and each element may often be found in the prior art. However, mere identification in the prior art of each element is insufficient to defeat the patentability of the combined subject matter as a whole. *In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998); *In re Kahn,* 441 F. 3d 977, 986 (Fed. Cir. 2006).

Thus, in summary, there is no motivation to combine the Bouevitch with the '923 patent since the combination would render Bouevitch unsatisfactory for its intended purpose,. Therefore, independent claims 1 and 8 are patentable over Bouevitch (U.S. 2003/0021526) ("Bouevitch") in view of Stone (U.S. patent 6,072,923, the '923 patent).

If the independent claims are nonobvious, claims that depend on those independent claims are also nonobvious. *In re Fine*, 837 F.2d 1071, 1071; 5 U.S.P.Q.2D (BNA) 1596 (Fed. Cir. 1988). Since claims 3-7 are dependent on claim 1, claims 9-13 are dependent on claim 8, claim 18 is dependent on claim 9 and claim 21 is dependent on claim 8, Applicant respectfully states that

claims 3-7, 9-13, and 18 and 21 are patentable over Bouevitch (U.S. 2003/0021526) ("Bouevitch") in view of Stone (U.S. patent 6,072,923, the '923 patent).

Furthermore, regarding claim 21, Applicant respectfully state that a phase conjugate mirror, as understood by one of ordinary skill in the art, retroreflects all incoming rays back to their origin (see, for example, http://www.photonics.cusat.edu/Research_Nonlinear%20Optics_OPC.html). The figure below, illustrates the differences between conventional mirrors and phase conjugate mirrors.



If the modifying means 650 in Figure 6a of Bouevitch were a phase conjugate mirror, the resulting system would be as in the modified Figure 7 or modified Figure 6a previously discussed above. Therefore, there would be no motivation to modify Bouevitch by replacing the modifying means 650 with a phase conjugate mirror since it would render the resulting system inoperable.

Therefore, Applicant asserts that claims 1, 3-13, 18 and 21 are patentable over Bouevitch in view of the '923 patent.

<u>Claims 14-17 and 19-20 were rejected under 35 U.S.C. 103(a) as being unpatentable over Bouevitch in view of Shirasaki (U.S. 2002/0114090) ("Shirasaki").</u>

As stated above, independent claims 1 and 8 are clearly defined as patentable over the prior art cited thereagainst for the reasons presented above, and independent claim 14 is also patentable for similar reasons presented and clearly since Bouevitch does not disclose a holographic mirror having "reflection properties different from a conventional mirror, [such that,] in reflecting the distinct chromatic components, a direction of propagation of said distinct chromatic components is altered by means of diffraction by said holographic mirror; and whereby, in reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of said reflected distinct chromatic components and a normal to a surface of said holographic mirror, said reflected distinct chromatic components emanating from the surface.

"Shirasaki et al. do not disclose a holographic mirror having reflection properties different from a conventional mirror, wherein,]in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror; and whereby, in reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface. Therefore, combining Bouevitch with Shirasaki et al. cannot be used to establish nor disclose a holographic mirror having reflection properties different from a conventional mirror, wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror; and whereby, in reflecting the

distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface.

As stated above, replacing the optical components in Bouevitch. with holographic mirrors having reflection properties different from a conventional mirror, wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror; and whereby, in reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface, since that replacement would render the Bouevitch invention inoperable. Combining Bouevitch with Shirasaki et al. introduces diffraction gratings but does not render the resulting system operable if the modifying means in Bouevitch are replaced with holographic mirrors having reflection properties different from a conventional mirror.

There is no motivation to replace the modifying means in Bouevitch with holographic mirrors having reflection properties different from a conventional mirror, wherein, in reflecting the distinct chromatic components, a direction of propagation of the distinct chromatic components is altered by means of diffraction by the holographic mirror; and whereby, in reflecting the distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of the reflected distinct chromatic components and a normal to a surface of the holographic mirror, the reflected distinct chromatic components emanating from the surface and combining Bouevitch with Shirasaki et al. does not alter that lack of motivation.

Furthermore, combining Bouevitch with Shirasaki et al.would render the resulting system inoperable. As shown below, combining Bouevitch with Shirasaki et al. results in the following version of Fig. 1b of Bouevitch would render the Bouevitch invention inoperable.

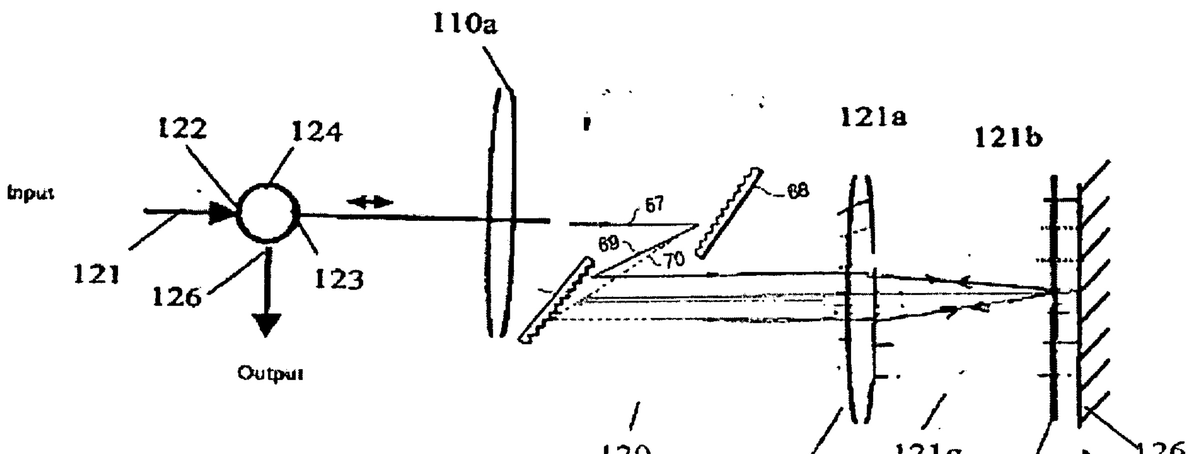


FIG 1b
(MODIFIED)

From the above figure, it can be seen that the separated paths are of equal length. Therefore, no chromatic compensation is achieved. Combining Bouevitch with Shirasaki would render the Bouevitch invention inoperable. Therefore, there would be no motivation to modify Bouevitch by replacing the separating means 120 with the separating means of Fig. 6a of Shirasaki since it would render the resulting system inoperable.

Applicant also respectfully states that there is no motivation to combine Shirasaki with Bouevitch since the pair of separating diffraction gratings does not provide any additional compensation for chromatic dispersion.(See, for example, paragraph 8 in the Applicant's specification.)

Therefore, Applicant asserts that independent claim 14, and claims 15-17 which depend therefrom as well as claims 19 and 20 which depend upon independent claim 8 (as argued above with respect to the Bouevitch and the '923 patent) are patentable over Bouevitch in view of Shirasaki (U.S. 2002/0114090) ("Shirasaki").

CONCLUSION

It is quite clear from the arguments presented above that (1) claims 1, 3-13, 18 and 21 are not obvious in light of Bouevitch in view of the '923 patent, and (2) claims 14-17, and 19- 20 are not obvious in light of Bouevitch in view of Shirasaki (U.S. 2002/0114090) ("Shirasaki"); therefore completely negating the 35 U.S.C. §103 rejections applied thereto;

In summary, Appellants respectfully submit that claims 1 and 3-21 are clearly patentable for the afore reasons and thus request this Honorable Board to reverse the decision of the Examiner.

In accordance with Section 714.01 of the M.P.E.P., the following information is presented in the event that a call may be deemed desirable by the Examiner:

JACOB ERLICH (617) 854-4000

Dated: June 13, 2006

Respectfully submitted
on behalf of Appellant,
Thomas W. Stone

By: [signature]

Jacob N. Erlich
Reg. No. 24,338
Attorney for Appellants

CLAIMS APPENDIX

1. (Previously Presented) A method for compensating for the chromatic dispersion in optical systems, the method comprising the steps of:

separating input optical radiation into distinct chromatic components;

propagating said distinct chromatic components through the optical system, said propagating including the steps of:

reflecting said distinct chromatic components from a holographic mirror; and,

providing, through said reflecting, a pre-selected relationship between optical path lengths of said distinct chromatic components, said pre-selected relationship substantially compensating for the chromatic dispersion;

recombining said distinct chromatic components, after propagating through the optical system;

wherein, in order to provide said pre-selected relationship, said holographic mirror has reflection properties different from a conventional mirror;

wherein, in reflecting said distinct chromatic components, a direction of propagation of said distinct chromatic components is altered by means of diffraction by said holographic mirror;

whereby, in reflecting said distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of said reflected distinct chromatic components and a normal to a surface of said holographic mirror, said reflected distinct chromatic components emanating from said surface.

2. (Canceled)

3. (Original) The method of claim 1 wherein the step of reflecting said distinct chromatic components further comprises the step of:

reflecting said distinct chromatic components from a switchable pixellated holographic mirror.

4. (Original) The method of claim 1 further comprising the step of:

focusing the input optical radiation.

5. (Original) The method of claim 1 wherein the step of separating input optical radiation into distinct chromatic components comprises the step of:

propagating the input optical radiation through at least one separating diffraction grating.

6. (Original) The method of claim 5 wherein the step of recombining said distinct chromatic components comprises the step of:

propagating the distinct chromatic components through at least one recombining diffraction grating.

7. (Original) The method of claim 6 wherein said at least one recombining diffraction grating is the same as said at least one separating diffraction grating.

8. (Previously Presented) A chromatic dispersion compensated optical system comprising:

an optical separating sub-system capable of separating input optical radiation into distinct chromatic components;

an optical recombining sub-system capable of recombining said distinct chromatic components for output; and,

a volume holographic mirror capable of reflecting said distinct chromatic components and providing, through said reflecting, a pre-selected relationship between optical path lengths through the optical systems of said distinct chromatic components, said pre-selected relationship substantially compensating chromatic dispersion; said volume holographic mirror being optically disposed between said optical separating sub-system and said optical recombining sub-system;

wherein, in order to provide said pre-selected relationship, said volume holographic mirror has reflection properties different from a conventional mirror;

wherein, in reflecting said distinct chromatic components, a direction of propagation of said distinct chromatic components is altered by means of diffraction by said holographic mirror;

whereby, in reflecting said distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of said reflected distinct chromatic components and a normal to a surface of said holographic mirror, said reflected distinct chromatic components emanating from said surface.

9. (Previously Presented) The optical system of claim 8 further comprising:

a switchable element selected from the group consisting of a switchable grating, a switchable mirror array, a switchable liquid crystal array, a cross-connect, an add-drop multiplexer, an interleaver and a band channelizer;

said switchable element optically interposed between said volume holographic mirror and said optical recombining sub-system.

10. (Previously Presented) The optical system of claim 8 further comprising:

an optical focusing component capable of focusing separated input optical radiation onto said volume holographic mirror.

11. (Previously Presented) The optical system of claim 8 wherein said volume holographic mirror comprises a pixellated switchable holographic mirror.

12. (Original) The optical system of claim 8 wherein said optical recombining sub-system is the same as said optical separating sub-system.

13. (Previously Presented) The optical system of claim 9 further comprising:

a directing optical element capable of directing the separated input optical radiation to said volume holographic mirror; and,

a redirecting optical element capable of redirecting optical radiation reflected from said volume holographic mirror to the switchable element.

14. (Previously Presented) A chromatic dispersion compensated optical system comprising:

a pair of separating diffraction gratings capable of separating input optical radiation into distinct chromatic components;

a holographic mirror capable of reflecting said distinct chromatic components and providing, through said reflecting, a pre-selected relationship between optical path lengths of said distinct chromatic components through the optical system, said pre-selected relationship substantially compensating chromatic dispersion; and,

a switchable element capable of receiving the separated distinct chromatic components and outputting separated distinct output chromatic components;

a pair of recombining diffraction gratings capable of recombining said outputted separated distinct chromatic components;

said switchable element being optically interposed between said holographic mirror and one of said pair of recombining diffraction gratings;

wherein, in order to provide said pre-selected relationship, said holographic mirror has reflection properties different from a conventional mirror;

wherein, in reflecting said distinct chromatic components, a direction of propagation of said distinct chromatic components is altered by means of diffraction by said holographic mirror;

whereby, in reflecting said distinct chromatic components by means of diffraction, an angle of incidence does not equal an angle between a direction of propagation of said reflected distinct chromatic components and a normal to a surface of said holographic mirror, said reflected distinct chromatic components emanating from said surface.

15. (Previously Presented) The optical system of claim 14 wherein the switchable element comprises:

a switchable element selected from the group consisting of a switchable grating, a switchable mirror array, a switchable liquid crystal array, a cross-connect, an add-drop multiplexer, an interleaver and a band channelizer.

said switchable element optically interposed between said volume holographic mirror and said optical recombining sub-system.

16. (Previously Presented) The optical system of claim 14 further comprising:

an optical focusing component capable of focusing separated input optical radiation onto said holographic mirror.

17. (Original) The optical system of claim 14 wherein said pair of recombining diffraction gratings is the same as said pair of separating diffraction gratings.

18. (Previously Presented) The optical system of claim 9 further comprising:

a directing optical element capable of directing the separated input optical radiation to the volume holographic mirror;

a redirecting optical element capable of redirecting optical radiation reflected from the volume holographic mirror to the switchable element.

19. (Original) The optical system of claim 8 wherein said optical separating sub-system comprises:

a pair of diffraction gratings.

20. (Original) The optical system of claim 8 wherein said optical recombining sub-system comprises:

a pair of diffraction gratings.

21. (Previously Presented) The optical system of claim 8 wherein said volume holographic mirror comprises a phase conjugate mirror.

THE EVIDENCE APPENDIX

Hetch, *Optics*, ISBN 0-201-11609-X, pp. 83 and 154

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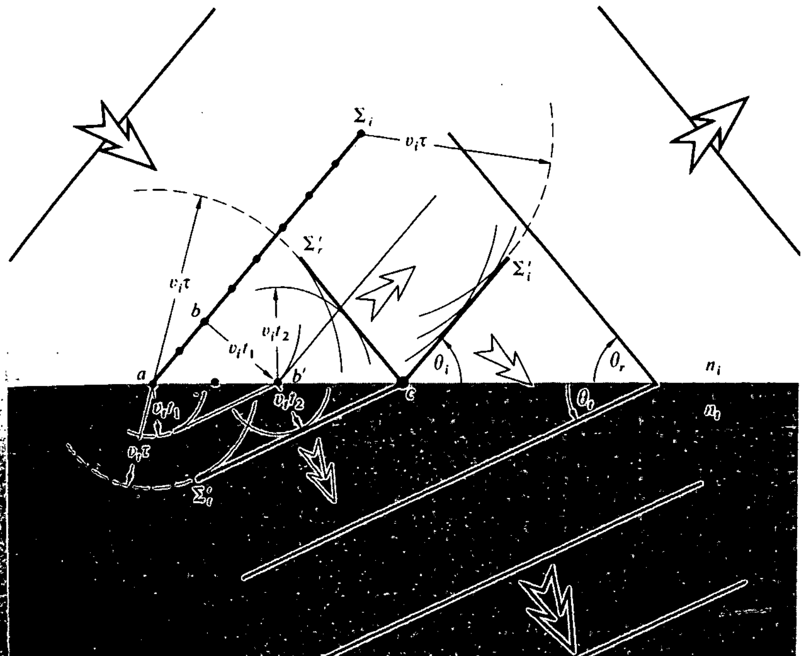


Figure 4.6 Reflection and transmission at an interface via Huygens's principle.

should be self-explanatory. Figure 4.7 is a somewhat simplified version in which θ_i, θ_r, and θ_t, as before, are the angles of *incidence*, *reflection*, and *transmission* (or *refraction*), respectively. Notice that

$$\frac{\sin\theta_i}{\overline{BD}} = \frac{\sin\theta_r}{\overline{AC}} = \frac{\sin\theta_t}{\overline{AE}} = \frac{1}{\overline{AD}}. \tag{4.1}$$

By comparison with Fig. 4.6, it should be evident that

$$\overline{BD} = v_i t, \qquad \overline{AC} = v_i t, \qquad \overline{AE} = v_t t,$$

so substituting into Eq. (4.1) and canceling t, we have

$$\frac{\sin\theta_i}{v_i} = \frac{\sin\theta_r}{v_i} = \frac{\sin\theta_t}{v_t}. \tag{4.2}$$

It follows from the first two terms that **the angle of incidence equals the angle of reflection**, that is,

$$\theta_i = \theta_r. \tag{4.3}$$

Known as the **law of reflection**, it first appeared in the book entitled *Catoptrics*, which was purported to have been written by Euclid.

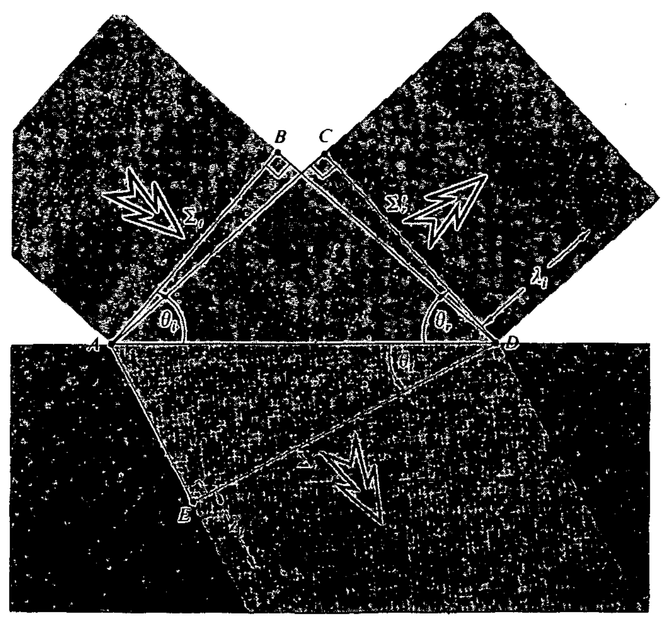
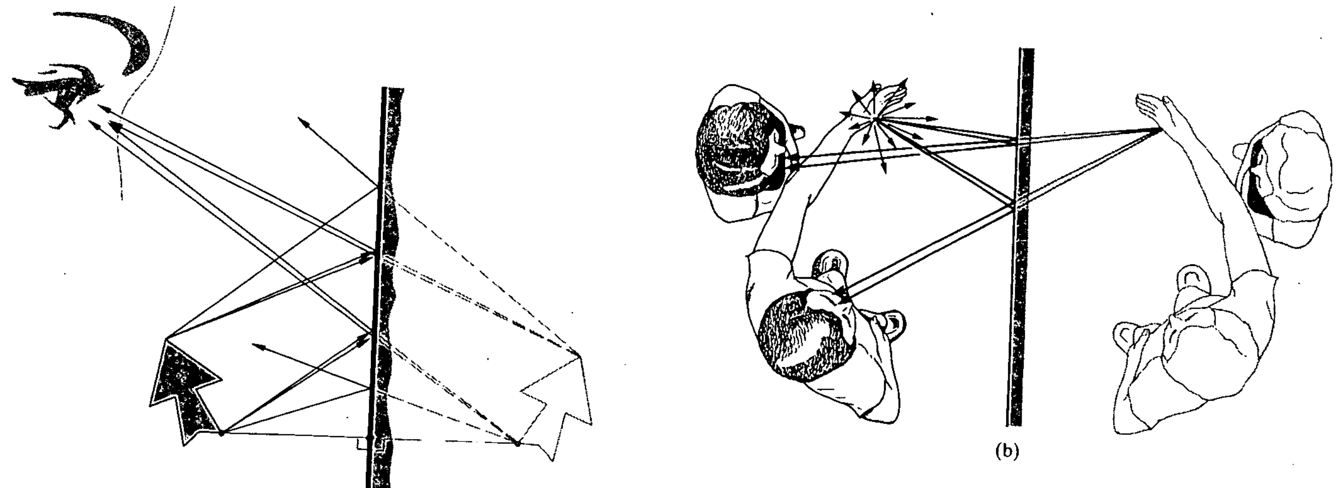


Figure 4.7 Reflected and transmitted wavefronts at a given instant.



(a) (b)

Figure 5.39 (a) The image of an extended object in a planar mirror. (b) Images in a planar mirror.

From Sections 4.2.2 and 4.2.3, it's a rather easy matter to determine the image characteristics of a planar mirror. Examining the point source and mirror arrangement of Fig. 5.38, we can quickly show that $|s_o| = |s_i|$, that is, the image P and object S are equidistant from the surface. To wit, $\theta_i = \theta_r$, from the law of reflection; $\theta_i + \theta_r$ is the exterior angle of triangle SPA and is therefore equal to the sum of the alternate interior angles, $\measuredangle VSA + \measuredangle VPA$. But $\measuredangle VSA = \theta_i$, and therefore $\measuredangle VSA = \measuredangle VPA$. This makes triangles VAS and VPA congruent, in which case $|s_o| = |s_i|$. (Go back and take another look at Problem 4.3 and Fig. 4.50 for the wave picture of the reflection.)

We are now faced with the problem of determining a sign convention applicable to mirrors. Whatever we choose, and you should certainly realize that there is a choice, we need only be faithful unto it for all to be well. One obvious dilemma with respect to the convention for lenses is that now the virtual image is to the right of the interface. The observer sees P to be positioned behind the mirror, because the eye (or camera) cannot perceive the actual reflection; it merely interpolates the rays backward along straight lines. The rays from P are diverging, and no light can be cast upon a screen located at P—the image is certainly virtual. Clearly, it is a matter of taste whether s_i should be defined as positive or negative in this instance. Since we rather like the idea of virtual object and image distances being negative, we shall define s_o *and* s_i *as negative when they lie to the right of the vertex V.* This will have the added benefit of yielding a mirror formula identical to the Gaussian lens equation (5.17). Evidently, the same definition of the transverse magnification

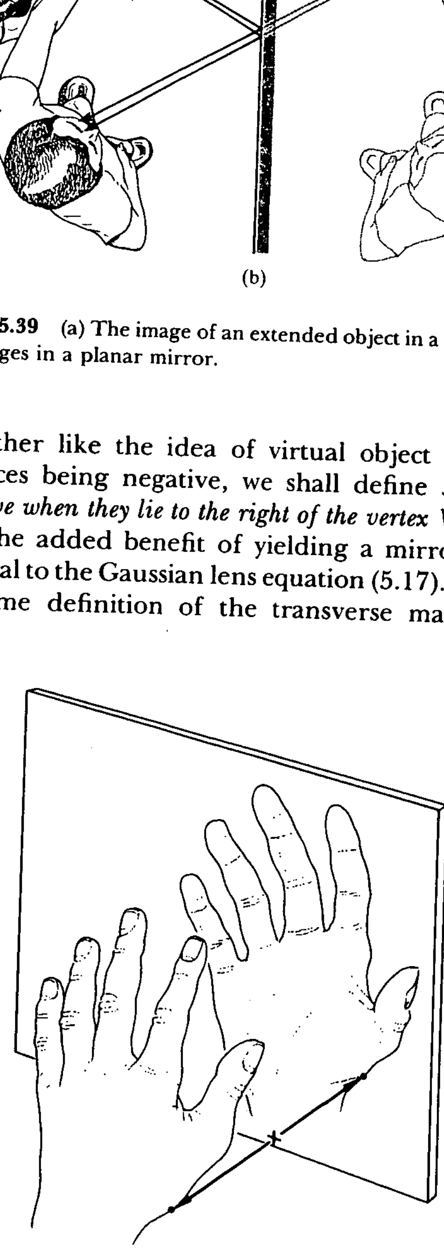


Figure 5.40 Mirror images—inversion.

Feynman Lectures on Physics, Vol. 1, p. 26-2, ISBN 0-201-02116-1-P

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The Feynman LECTURES ON PHYSICS

MAINLY MECHANICS, RADIATION, AND HEAT

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Although geometrical optics is just an approximation, it is of very great importance technically and of great interest historically. We shall present this subject more historically than some of the others in order to give some idea of the development of a physical theory or physical idea.

First, light is, of course, familiar to everybody, and has been familiar since time immemorial. Now one problem is, by what process do we *see* light? There have been many theories, but it finally settled down to one, which is that there is something which enters the eye—which bounces off objects into the eye. We have heard that idea so long that we accept it, and it is almost impossible for us to realize that very intelligent men have proposed contrary theories—that something comes out of the eye and feels for the object, for example. Some other important observations are that, as light goes from one place to another, it goes in *straight lines*, if there is nothing in the way, and that the rays do not seem to interfere with one another. That is, light is crisscrossing in all directions in the room, but the light that is passing across our line of vision does not affect the light that comes to us from some object. This was once a most powerful argument against the corpuscular theory; it was used by Huygens. If light were like a lot of arrows shooting along, how could other arrows go through them so easily? Such philosophical arguments are not of much weight. One could always say that light is made up of arrows which go through each other!

26–2 Reflection and refraction

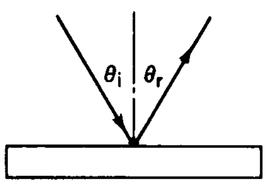

Fig. 26–1. The angle of incidence is equal to the angle of reflection.

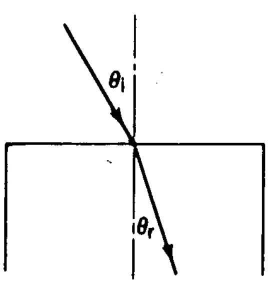

Fig. 26–2. A light ray is refracted when it passes from one medium into another.

Table 26–1

Angle in air	Angle in water
10°	8°
20°	15-1/2°
30°	22-1/2°
40°	29°
50°	35°
60°	40-1/2°
70°	45-1/2°
80°	50°

The discussion above gives enough of the basic *idea* of geometrical optics—now we have to go a little further into the quantitative features. Thus far we have light going only in straight lines between two points; now let us study the behavior of light when it hits various materials. The simplest object is a mirror, and the law for a mirror is that when the light hits the mirror, it does not continue in a straight line, but bounces off the mirror into a new straight line, which changes when we change the inclination of the mirror. The question for the ancients was, what is the relation between the two angles involved? This is a very simple relation, discovered long ago. The light striking a mirror travels in such a way that the two angles, between each beam and the mirror, are equal. For some reason it is customary to measure the angles from the normal to the mirror surface. Thus the so-called law of reflection is

$$\theta_i = \theta_r. \tag{26.1}$$

That is a simple enough proposition, but a more difficult problem is encountered when light goes from one medium into another, for example from air into water; here also, we see that it does not go in a straight line. In the water the ray is at an inclination to its path in the air; if we change the angle θ_i so that it comes down more nearly vertically, then the angle of "breakage" is not as great. But if we tilt the beam of light at quite an angle, then the deviation angle is very large. The question is, what is the relation of one angle to the other? This also puzzled the ancients for a long time, and here they never found the answer! It is, however, one of the few places in all of Greek physics that one may find any experimental results listed. Claudius Ptolemy made a list of the angle in water for each of a number of different angles in air. Table 26–1 shows the angles in the air, in degrees, and the corresponding angle as measured in the water. (Ordinarily it is said that Greek scientists never did any experiments. But it would be impossible to obtain this table of values without knowing the right law, except by experiment. It should be noted, however, that these do not represent independent careful measurements for each angle but only some numbers interpolated from a few measurements, for they all fit perfectly on a parabola.)

This, then, is one of the important steps in the development of physical law: first we observe an effect, then we measure it and list it in a table; then we try to find the *rule* by which one thing can be connected with another. The above numerical table was made in 140 A.D., but it was not until 1621 that someone finally found the rule connecting the two angles! The rule, found by Willebrord

http://www.photonics.cusat.edu/Research_Nonlinear%20Optics_OPC.html

Home I Research I Nonlinear Optics I Phase Conjugation

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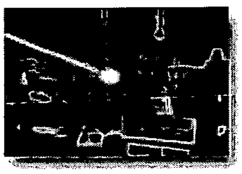
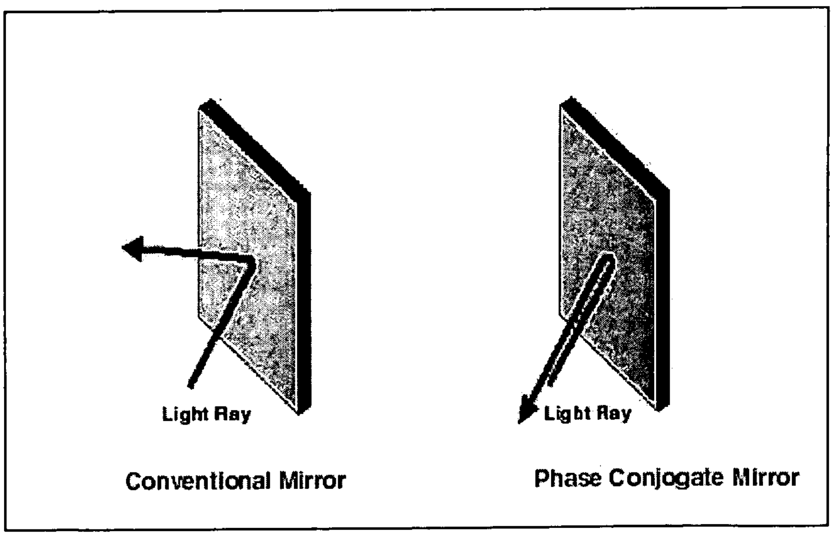


Nonlinear Optics

Optical Phase Conjugation

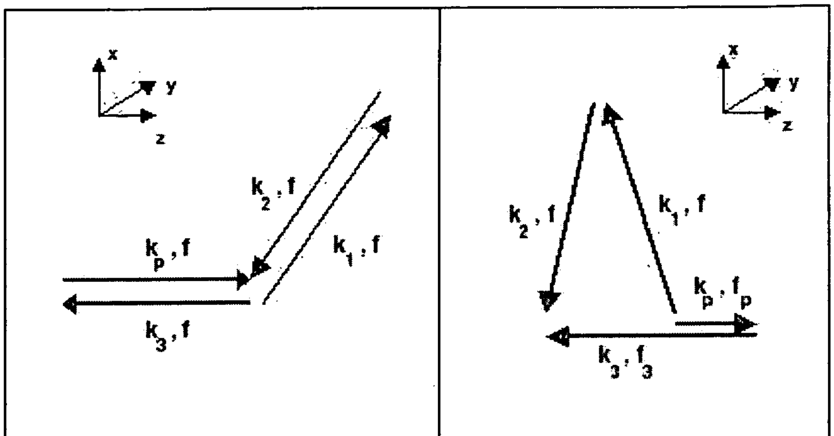
Optical phase conjugation (OPC) is used as a generic term for a multitude of nonlinear optical processes. The common feature is that all these processes are capable of reversing both the direction of propagation and the phase factor for each plane wave component of an arbitrary incoming beam of light. This means that a phase conjugator can be considered as a kind of mirror with very unusual reflection properties. Unlike a conventional mirror, where a ray is redirected according to the ordinary law of reflection, a phase conjugate mirror (PCM) retroreflects all incoming rays back to their origin. Thus, any optical beam that is reflected by a PCM will retrace its original path. When a ray is reflected by a conventional mirror only the wave vector component normal to the surface of the mirror changes sign. The tangential components are unchanged. This means that the propagation direction of the reflected ray depends on the angle between the surface normal and the incident ray. This is just a complicated way of describing our every-day experience that a beam of light can be precisely redirected by a mirror just by tilting it. A PCM, on the other hand, changes the sign of the complete wave vector so that the reflected ray is always antiparallel to the incident ray, independent of the orientation of the mirror surface.



Four Wave Mixing

Four wave mixing can be divided into degenerate four wave mixing (DFWM) and nondegenerate four wave mixing. DFWM is one of the most important processes used for OPC. It is a third-order nonlinear optical process involving the mixing of four separate optical waves, all with the same frequency. The three input waves consist of two antiparallel, high power pump or reference waves and a weaker probe wave. Two of the three input waves interfere and form either a spatially or temporally modulated grating; the third input wave is scattered by the grating to yield the output wave. In terms of photons DFWM can be

described as a parametric process where the energy from two pump photons, one from each wave, is converted into one probe and one output signal photon. The energy conservation requirement is obviously fulfilled in this case since all photons have the same frequency. To have an efficient energy transfer from the pumps to the probe and signal we must also have momentum conservation. With **k1**, **k2**, **kp** and **k3** as the wave vectors of the two pumps, the probe, and the signal wave, respectively, this so called phase-matching condition states that **k1** + **k2** = **kp** + **k3**. Since the two pump photons are antiparallel, with zero total momentum (**k1** + **k2** = 0), this means that the signal wave must be antiparallel to the probe wave. Momentum conservation is the basis of the phase-conjugate nature of the output signal in DFWM. Here the signal is proportional to the complex conjugate of the probe field. Since the output is directly related to the nonlinear response of the medium DFWM is often used to measure third-order nonlinearities.



Degenerate Four Wave Mixing	Nondegenerate Four Wave Mixing

In DFWM, the conjugated output wave is essentially at the same wavelength as the probe wave. To achieve phase conjugation with large frequency conversion we have to use nondegenerate four wave mixing. The phase matching scheme is shown above. In this case the two pump photons carry a nonzero total momentum in the z direction that is tuned to match the frequency difference of the probe and signal waves. As a consequence of this, exact phase matching can be achieved only for one direction of propagation of the probe wave.

- To know more, follow the link

RELATED PROCEEDINGS APPENDIX

No related proceedings.